

COMPARISON OF LAKE SINCLAIR COVE AND MAIN CHANNEL WATER QUALITY, 1998

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Abstract. The study evaluated water quality differences between coves and main channels in Lake Sinclair. Historic main channel data were compared to cove and main channel data for 1998. Significant water quality differences were found. Chlorophyll *a* values in coves were sufficient to cause scums, mats, and odors.

INTRODUCTION

Lake Sinclair is a 15,330 acre reservoir impounded in 1952, located near Milledgeville, Georgia. It is the lower reservoir for the Lake Oconee pumped storage operation at Wallace Dam. It contains 417 miles of shoreline, and has a mean depth of 21.8 ft. Daily average water level fluctuation is about 2.0 ft (Georgia Power Company, 1996).

In 1997, Rooty Creek residents complained about algae and odors near the shore. Some residents thought the odors were due to sewage drain fields needing repair. Historical records show that algae complaints have been received in the past from Rooty Creek and Little River residents. This area has also been studied by the USDA as a Non-point Source Demonstration Project (Segars, 1993).

This study was designed to evaluate differences in water quality between main lake channel and cove waters. These differences may explain the reasons for complaints from cove residents. Data from main channel sites previously sampled were included for comparison purposes.

METHODS

A total of 11 cove and 6 main channel sites were included in this study. Figure 1 notes the locations of the cove and main channel sites. Table 1 contains a brief description of the locations of these sites. Sampling was conducted twice monthly, from March 4 through September 22. Two additional samples were collected on October 13 and November 11.

At each sample location, a profile of temperature (TEMP), dissolved oxygen (DO), pH, and specific conductance (COND), was collected, along with a secchi depth. A Hydrolab Surveyor3 was used to collect the profile data, and a standard secchi disc was used to collect secchi depth. The Surveyor3 was calibrated prior to field use, and a post calibration check was made after each field use.

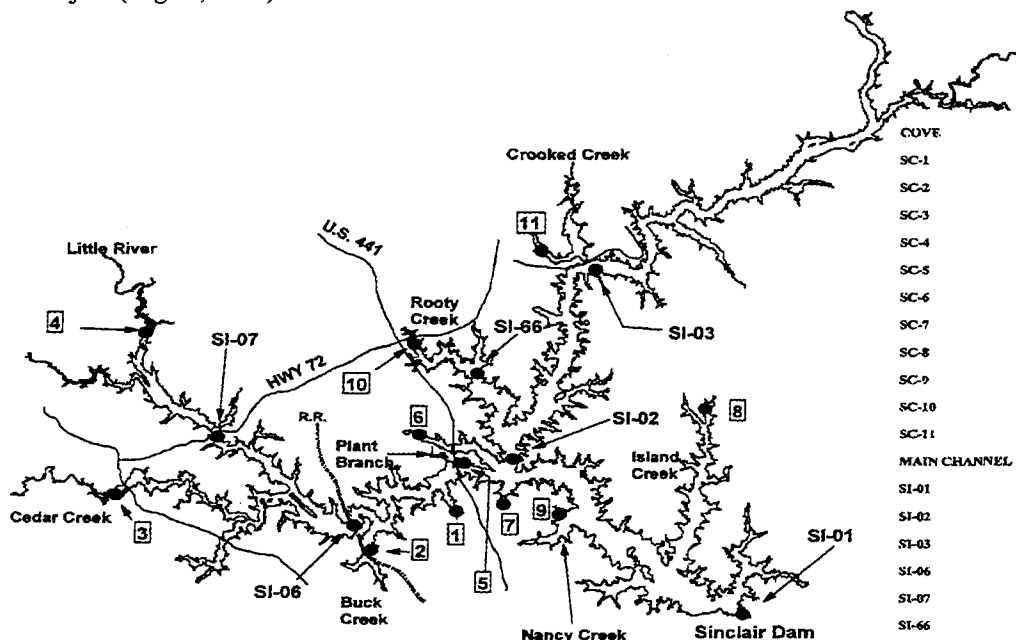


Figure 1. Lake Sinclair cove and main channel sampling stations, 1998.

Table 1. Cove / Main Channel Sampling Locations

Cove	
SC1-Upstream of Chobys Dock, -oxidation pond discharge in drainage	
SC2- Buck Creek Railroad Causeway	
SC3- Cedar Creek near Hgwy 212 - all National Forest drainage	
SC4- Little River above Murder Creek - under Transmission Lines	
SC5- Jerry's Marina - trailer park, restaurant, and marina runoff	
SC6- Beaverdam Creek - discharge area	
SC7- Sinclair Marina, near Temple Bay Estates trailer park	
SC8-Island Creek, back right fork, trailer homes	
SC9-Nancy Branch, mostly older homes	
SC10-Rooty Creek, mostly older homes	
SC11-Crooked Creek, mostly homes	
Main Channel	
SI1-Dam forebay	
SI2-Oconee River arm, under first uplake transmission line	
SI3-Oconee River arm, mid-channel opposite Crooked Creek bridge	
SI6-Little River arm, at first uplake railroad bridge	
SI7-Little River arm, at Double Bridges	
SI66-Rooty Creek, near Cold Branch junction	

Water samples were collected at each location and analyzed for ammonia (NH₃), chlorophyll *a* (CHL_a), fecal coliform(FECAL), nitrate+nitrite (NO₃+NO₂), total phosphorus (TOTP), and turbidity (TURB). Upon collection, the samples were placed in a cooler on ice and transported to the lab for analyses. Nutrient samples were preserved with sulfuric acid prior to placement in the cooler. FECAL samples were incubated within 30 hours of collection, and results are estimated. Analyses followed Standard Methods, 19th Edition (1996).

Resulting data were compared for significant (p<0.05) differences between cove and main channel sites using t-tests on a personal computer, as described in SAS (1996).

RESULTS

Historical profile and water chemistry data from main channel stations are compared in Table 2.

Compared to historical data (1988-1997), the main channel stations in 1998 were 0.9°C warmer, contained 0.5 mg/l more DO, had a mean pH 0.04 units lower, and had 3 umho/cm less COND. Secchi depth measurements were not different. Main channel historical (1992-1997) chemical data compared to 1998 data indicated that for 1998: TOTP was 0.01 mg/l lower, NO₃+NO₂ was 0.07 mg/l higher, and trophic state index (Carlson, 1977) based on chlorophyll *a* was 4 units higher. Ammonia, chlorophyll *a*, fecal coliform, and turbidity were not different.

Table 3 contains comparisons of mean cove and main channel profile and water chemistry data for 1998. TEMP, DO, pH, and COND were higher at cove sites. Only secchi depth was greater in the main channel sites. TOTP, FECAL, and TURB were higher at the cove sites, while NO₃+NO₂ was higher in the main channel sites. NH₃, CHL_a, and TSI indexes were not significantly different.

Table 4 notes similar comparisons between cove and main channel sites for July-August data. The cove sites had greater TEMP, DO, pH, and COND values than main channel sites. Secchi depth was greater in the main channel sites. Cove sites had greater FECAL than main channel sites, and main channel sites had

Table 2. Comparison of March-November Historical Main Channel Data to 1998 Data

Profile Data (since 1988)			
Measurement	1998	historical	significance
Temp (°C)	23.8 *	22.9	P<0.05
DO (mg/l)	6.7 *	6.2	P<0.05
pH (units)	6.97	7.01 *	P<0.05
COND (umho/cm)	62	65 *	P<0.05
Secchi Depth (ft)	2.5	2.9	n.s.
Chemistry Data (since 1992)			
Measurement	1998	historical	significance
TOTP (mg/l)	0.02	0.03 *	P<0.05
NO ₃ +NO ₂ (mg/l)	0.27 *	0.20	P<0.05
NH ₃ (mg/l)	0.04	0.03	n.s.
CHL _a (ug/l)	8.3	6.6	n.s.
FECAL (#/100ml)	32	232	n.s.
TURB (NTU)	18.4	15.9	n.s.
TSI(CHL _a)	49 *	45	P<0.05
TSI(TOTP)	51	52	n.s.

Table 3. Sinclair Cove/Main Channel Mean Comparisons, March-November Data, 1998

Profile Data			
Measurement	Cove	Main Channel	significance
TEMP (°C)	24.7 *	23.7	P<0.05
DO (mg/l)	7.6	6.7	P<0.05
PH (units)	7.2 *	7.0	P<0.05
COND (umho/cm)	66 *	62	P<0.05
Secchi Depth (ft)	2.0	2.5 *	P<0.05

Chemistry Data

Measurement	Cove	Main Channel	significance
TOTP (mg/l)	0.03 *	0.02	P<0.05
NO3+NO2 (mg/l)	0.21	0.27 *	P<0.05
NH3 (mg/l)	0.03	0.04	n.s.
CHLa (ug/l)	9.2	8.3	n.s.
FECAL (#100ml)	57 *	32	P<0.05
TURB (NTU)	20.7 *	18.4	P<0.05
TSI CHLa	50	49	n.s.
TSI TOTP	53	51	n.s.

greater NO3+NO2 than cove sites. The remaining chemical analyses were not different.

The mean comparisons in Tables 3-4 describe water quality during 1998, but do not indicate sources of resident complaints about algae and odors. The data in Table 5 indicate that Rooty Creek stations (SC10, SI66) contained maximum values for TOTP (cove and main channel), NO3+NO2, CHLa, NH3, and FECAL.

Eutrophic levels of TOTP and CHLa were noted in Rooty Creek, along with FECAL levels exceeding the State standard (200/100ml). The Rooty Creek CHLa values exceed "nuisance" and "severe nuisance" levels (40 and 60 ug/l, respectively) for CHLa as determined by Lake Pepin users near Minneapolis, MN (Heiskary and Walker, 1995).

Figures 1-3 show cove and main channel stations with maximum monthly values found for TOTP, CHLa and FECAL. Note that TOTP values equal or exceed the EPA recommended limit for in-lake phosphorus of 50 ug/l for all months except November. CHLa values at STA SC10 exceed 10 ug/l in all months. CHLa levels over 10 ug/l are reported by Raschke (1993) to be associated with water discoloration, algal scums and matting.

Table 4. Sinclair Cove/Main Channel Mean Comparisons, July-August Data, 1998

Profile Data			
Measurement	Cove	Main Channel	significance
TEMP (°C)	31.3 *	30.4	P<0.05
DO (mg/l)	6.4	5.2	P<0.05
PH (units)	7.4 *	7.0	P<0.05
COND (umho/cm)	70 *	67	P<0.05
Secchi Depth (ft)	2.3	2.8 *	P<0.05

Chemistry Data

Measurement	Cove	Main Channel	significance
TOTP (mg/l)	0.02	0.01	n.s.
NO3+NO2 (mg/l)	0.17	0.31 *	P<0.05
NH3 (mg/l)	0.02	0.02	n.s.
CHLa (ug/l)	9.1	8.7	n.s.
FECAL (#100ml)	57 *	31	P<0.05
TURB (NTU)	13.7	10.0	n.s.
TSI CHLa	49	49	n.s.
TSI TOTP	49	46	n.s.

Table 5. Maximum Water Chemistry Values from Coves and Main Channel Stations, 1998

Station	TOTP mg/l	NH3 mg/l	NO3+NO2 mg/l	CHLa ug/l	TURB NTU	FECAL #/100ml
Coves:						
SC01		0.31				
SC02					70	
SC03						280
SC10	0.36		0.98	70		
Main Channel:						
SI02					60	
SI06			0.96		60	
SI07				27.6		
SI66	0.14	0.35				275

CONCLUSIONS

Warmer TEMP found in 1998 were not associated with greater CHLa values, although DO values were greater than the historical record. This is likely due to reduced TOTP values in 1998. However, localized TOTP values were sufficient to allow nuisance growths of algae, reflected in increased CHLa values. These peaks of CHLa are likely associated with algal scums, odors, and objectionable colors.

The 1998 main channel TOTP data was less than the historical mean. However, cove TOTP values were

significantly higher than main channel values, and would be expected to behave similarly in the past. Therefore, one could infer that historical complaints were based on similar algal blooms occurring in Rooty Creek, and elsewhere in the coves of Lake Sinclair, where sufficient TOTP exists for excessive algal growths.

Continued reductions in TOTP loading to Lake Sinclair from the surrounding watershed should help reduce algal bloom intensity and frequency.

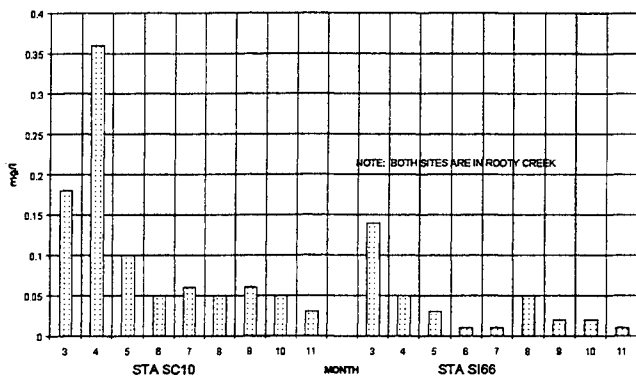


Figure 1. Sinclair Lake, 1998, cove and main channel stations with maximum TOTP concentrations.

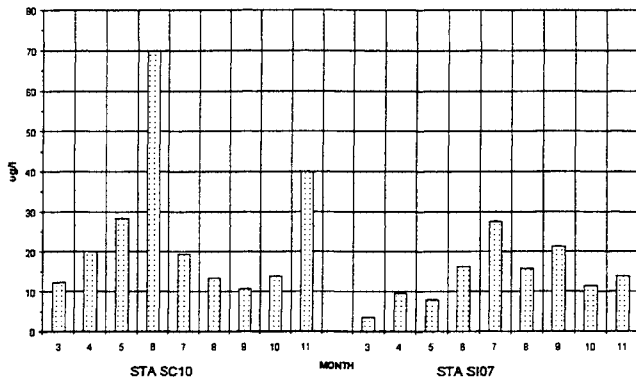


Figure 2. Sinclair Lake, 1998, cove and main channel stations with maximum FECAL concentrations.

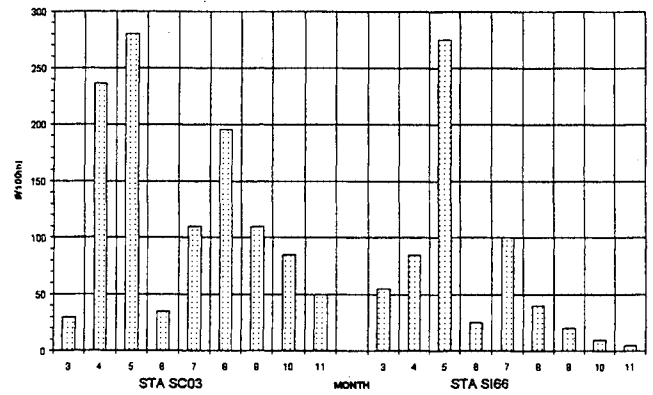


Figure 3. Sinclair Lake, 1998, cove and main channel stations with maximum CHLa concentrations.

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